

Experience from the Automotive Industry in Moving to a Higher Level of Quality Management

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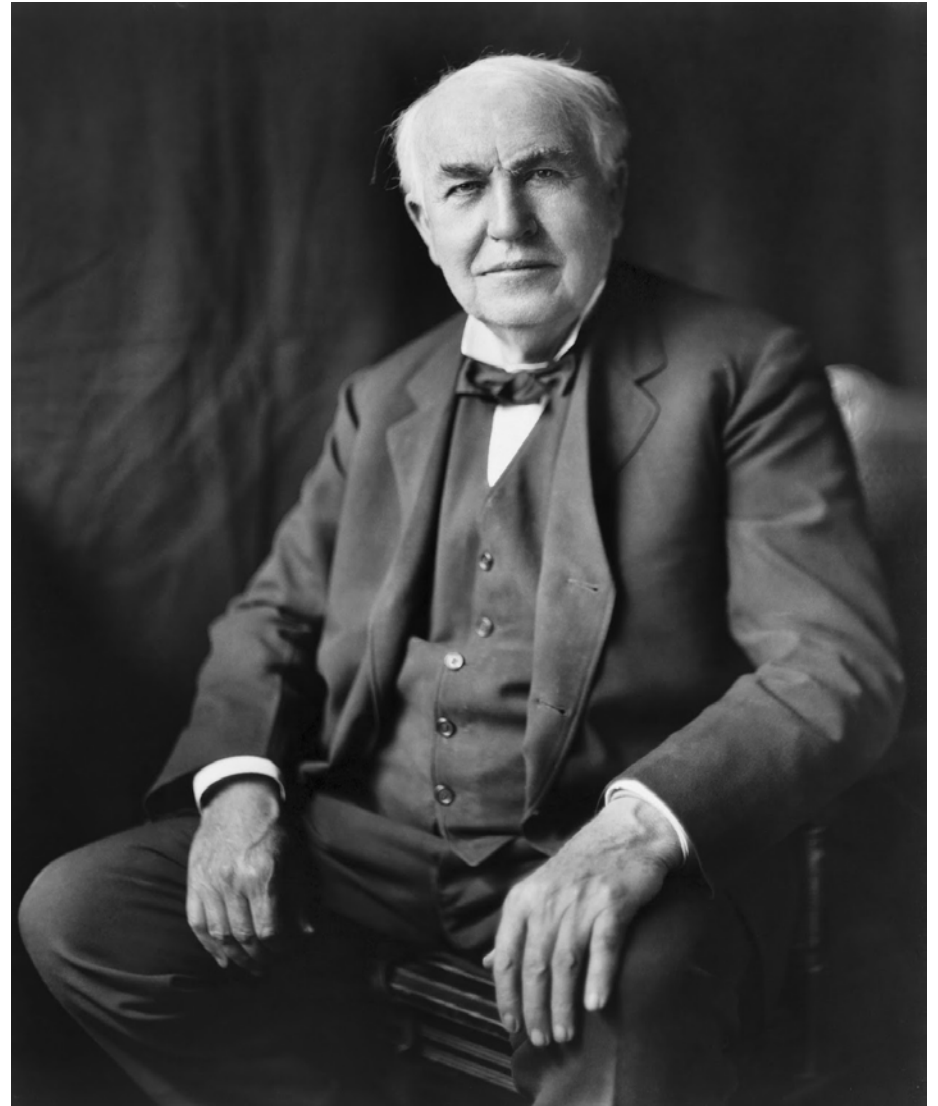
Solar Power 10/20/2014
International 2014 – Las
Vegas

James Moore - Bios

- 48 years of experience in automotive engineering and manufacturing
 - British Leyland - Chief Engineer: Military
 - General Motors - Senior Integration Engineer
 - American Axle - GM Liaison Engineer
- Chartered Mechanical Engineer
- Fellow of the Institution of Mechanical Engineers
- Holds automotive patents in multiple countries
- Design Council Award Winner - UK

Thomas Edison

- Edison took electricity and made light.
- We are now taking light and making electricity!



Goal

Find a path to improving the **reliability** and **quality** of PV panels by drawing on experience from the automotive industry with particular regard to quality control systems.

Distinguish between quality control and specifications

Outline

1. How do you Define Quality?
2. Typical Improvements in the Auto Industry
3. History of Quality Control in Manufacturing
4. The Role of Specification – Exact Requirements
5. Quality Control in the Auto Industry
6. Ideas and Conclusion's

Why Don't Dashboards Crack Anymore?

How did the auto industry improve quality?

What is quality?

Has the very word become meaningless?



Mount Blanc Pen – \$500 / pen



Blue Bic Pen – \$0.05 / pen

ISO 9000 in the Auto Industry

The auto industry used ISO 9000 to improve quality.....
right?

Any claims for the role of quality control systems, such as ISO9000, have to address the issue of the unprecedented extent of recalls in the last two years



ISO9000 was a tool intended make the product match the specification – not *change* the specification

Can updated Quality control systems, such as ISO9001, provide *practical* feedback loops to the design process?

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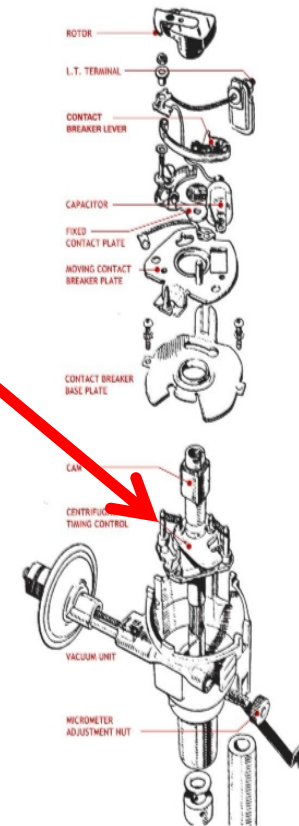
Typical Improvements in Auto Industry: Model T to Modern Day

Model T – Advance Retard Lever



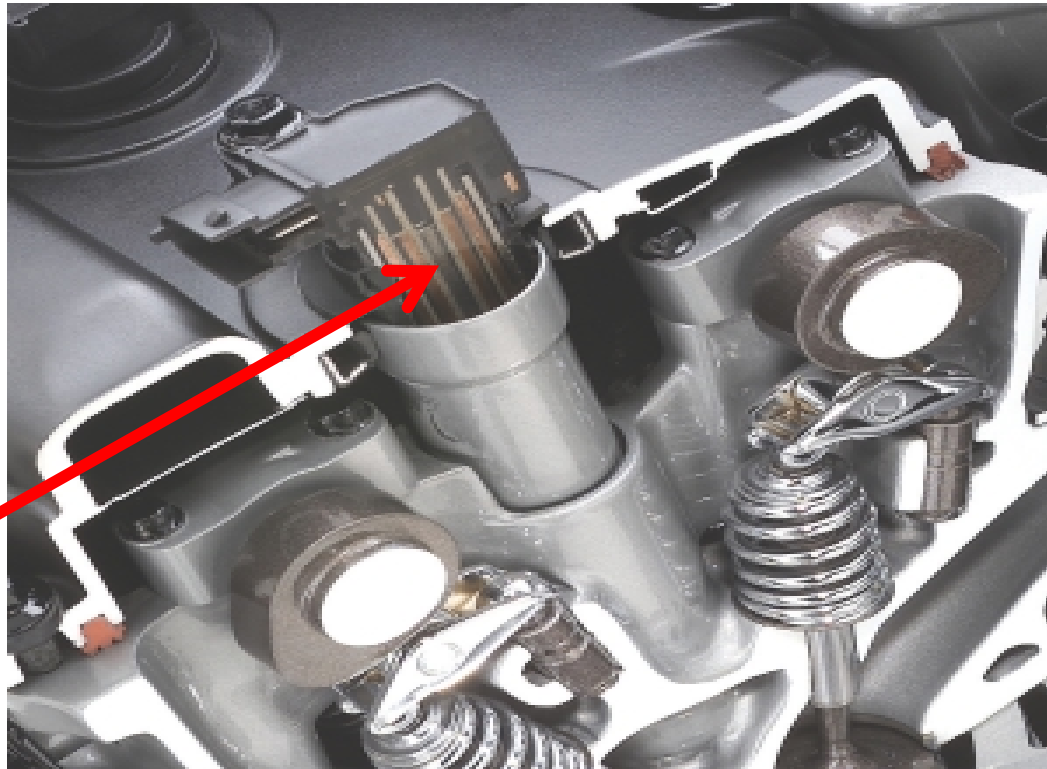
Typical Improvements in Auto Industry: Model T to Modern Day

Automated – Advance Retard Lever



Typical Improvements in Auto Industry: Model T to Modern Day

Computer Controlled Advance Retard Ignition



Typical Improvements in Auto Industry: Model T to Modern Day

Multi-pin Connector – Poke yoke 40 years ago



Typical Improvements in Auto Industry: Model T to Modern Day

Layland Truck Instrument Panel -Six Identical Ammeters



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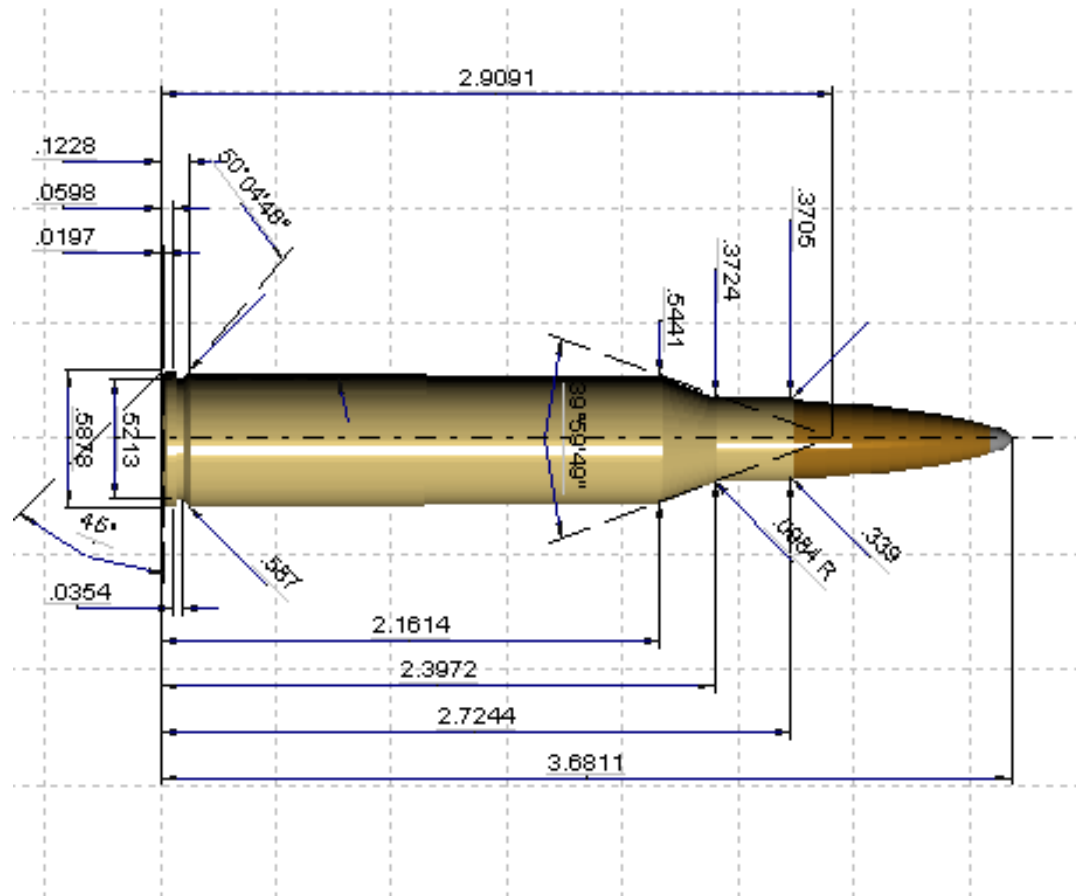
History of Quality Control in Manufacturing

Ammunition Manufacturing in World War I



History of Quality Control in Manufacturing

Ammunition Manufacturing in World War I



History of Quality Control in Manufacturing

History of Quality Control

1700 The maker's reputation (Manf. was a single person)

1800 The trade guilds (Master Tinsmith, Master Mason, etc)

1900 100% Inspection

2000 Control of Process – Auto Inspection

2100 The “Talking Chip” – Automatic Diagnostics

Where does ISO 9000 Fit In?

History of Quality Control

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You are here



2100 The “Talking Chip” – Automatic Diagnostics

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Auto Experience to PV Industry

Accelerated Testing

Belgian Pave

- 1-5 years “damage” in a few days
- Meaningful over stressing
- Find a mechanism to take you up the fatigue curve

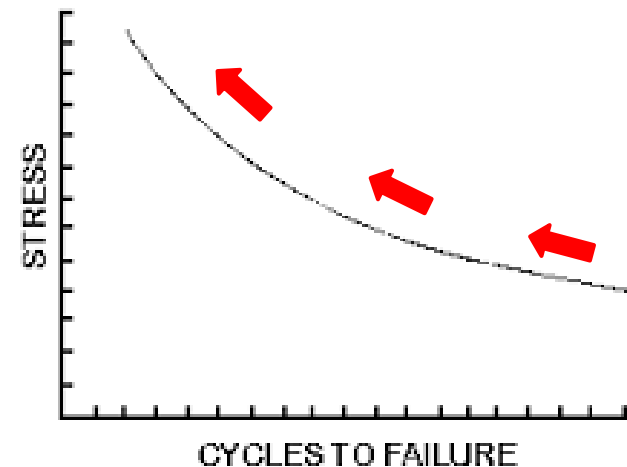


Auto Experience to PV Industry

Accelerated Testing

Belgian Pave equivalent for PV?

- PV Industry must find and utilize accelerated tests
- Not just more cycles faster
- You need to find a way to increase stress on failure mechanisms



Find the Pave like test for PV test that is meaningful!

Is there a thermal shock equivalent for PV?

The Role of Specification - To provide Exact Requirements.

Set the Specification!

- **You cannot say whether a component is satisfactory unless your specification is exact**
- **A component cannot be more or less than a value that has not been enumerated.**
- **A quality control system cannot do its policing without a fool proof specification**

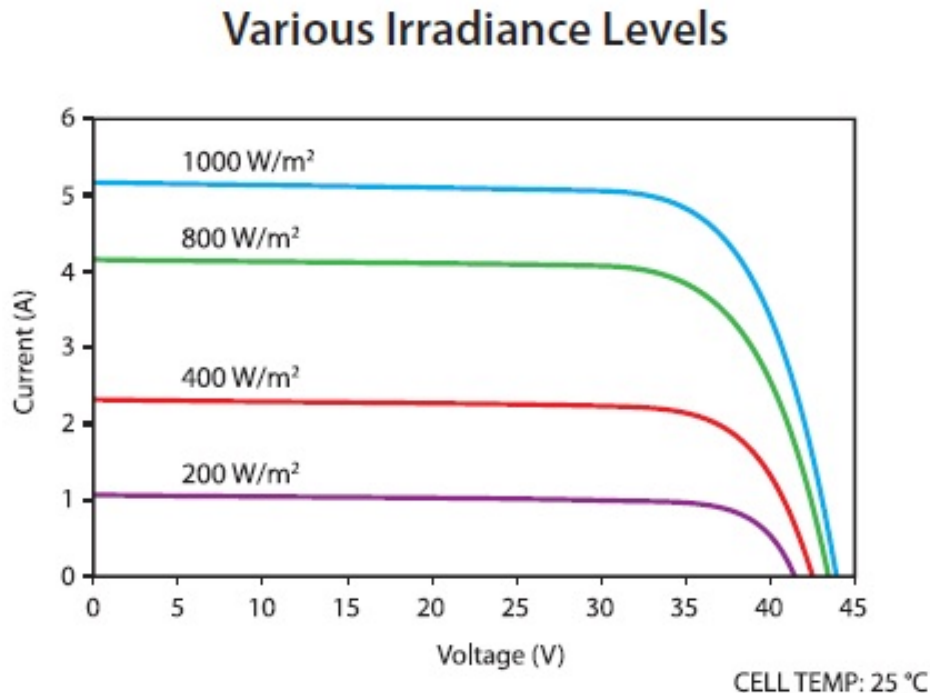
The Role of Specification - Exact Requirements

On Board Diagnostics – Flight MH370



The Role of Specification - Exact Requirements

On Board Diagnostics – Can a PV panel, string or array have a signature?



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Quality Control in the Auto Industry

Agreement of Specification



Quality Control in the Auto Industry

Are you Controlling Your Suppliers?

**GM is very good at controlling its suppliers
(as was Sir Isaac Newton)**



Quality Control in the Auto Industry

Tools inside an ISO9000 environment

Suppliers ISO9000

DFMEA - Design Failure Mode Effect and Analysis

PFEMA - Process Failure Mode Effect and Analysis

PPAP - Pre Production Approvals Process

Six Sigma - Analysis of natural distribution

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Ideas - More Diagnostics

Automated Signature Analysis

- **IV Curves**

Can the PV industry use minute examination of IV curve sweeps in the factory and in the field to predict reliability?

- **Electroluminescence**

Can the PV industry use minute examination of electroluminescence images in the factory and in the field to predict reliability?

Conclusions

- 1. Quality Control systems such as ISO9000, were intended, like a climbers rope, to keep you safe wherever you position yourself. They were not designed - per se - to get you further up the mountain.**
- 2. A better specification is the essential ingredient of a better product. Some skepticism should be reserved for quality control systems that claim that they can 'design'.**
- 3. By controlling your processes you can accelerate to 'Year 2100' type Quality Control like Rolls-Royce Aero engines... the "talking chip" - computers talking to computers.**